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VALUE OF STERNAL PUNCTURE IN OCCUPATIONAL POISONING

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Many have described the value of bone marrow obtained by puncture and its analysis in establishing the pathogenesis of a disease. However, this method has yet to be accepted generally in the field of occupational diseases.

In view of the fact that the majority of industrial poisons act on the hemopoiesis, the author resolved to conduct experiments on living white rabbits and guinea pigs to study the effects of various industrial poisons on the bone marrow. Dynamic studies were conducted on the composition of peripheral blood and bone-marrow-puncture specimens of animals subjected to acute as well as chronic poisoning by trinitrotoluene, nitrogen oxides, chlorine, and cyanide compounds, as well as dilute gas (butane-propane-butylene mixture). A total of 600 punctures was made.

It is interesting to note that the results of simultaneous examinations of bone marrow obtained from the ribs and sternum were similar. Thus, it can be stated that the above data does not substantiate Tsadek's theory that such poisoning does not affect the whole bone-marrow system.

Dynamic studies of the peripheral blood revealed three types of poisonous effects; (1) erythrocytosis and leucocytosis in peripheral blood without any changes in the basic blood-forming process, (2) irritation of the bone marrow, which in turn affects the condition of the peripheral blood, and (3) acute changes in the bone marrow in regard to both leucopoesis or erythropoesis without appreciable change in the peripheral blood.

Cyanide compounds and gaseous products of combustion are those which produce the first-mentioned effect. Many experiments revealed that poisoning by sodium cyanide or prussic acid does not bring about any changes in bone-marrow-puncture

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bone-marrow-puncture material. Severe poisoning results in a malignant form of acute anemia (death occurs after 4-5 days), while in cases of chronic poisoning anemia comes on slowly but has the same characteristics.

Studies of the leucocytes indicated leucopenia without any significant shifts in the leucocytic formula, while lymphocytosis was observed only just prior to death. During the first phase of the experiments reticulocytes were rather abundant but subsequently decreased and toward the end of the experiments became completely absent from the peripheral blood.

Studies of bone-marrow-puncture specimens revealed sharply defined changes in the erythropoiesis and leucopoieses, which, however, are characteristically regular.

In the acute stage, i.e., with the start of poisoning of the bone marrow, there is an increase in the blood-producing processes from the very first day of poisoning. Not only an increased amount of immature erythroid and leucoblast type cells, but also an increase in the number of mytotic cells is observed. This latter finding proves that there is increased irritation of the bone marrow.

Subsequent to the above findings the blood-producing process indicated pathologic changes and disruption of the maturing of cells. Simultaneously, the bone marrow was filled with embryonic cells, the number of intermediate form of cells decreased; in some cases these intermediate forms were completely lacking. The number of matured cells also decreased. It is interesting to note that in spite of the fact that there are many embryonic cells in the bone marrow, no shifts are observed in the peripheral blood other than a somewhat increased number of reticulocytes.

In cases of chronic trinitrotoluene poisoning, increased blood production was observed only during the first months of the poisoning. Starting 7 to 8 months subsequent to exposure, there is an accompanying decrease in the number of formative elements. Degenerative changes are observed in many myelocytes (pyknesis, vacuolization of the protoplasm, accumulation of structureless nuclei, etc.). As the poisoning progresses, the producing centers are replaced by fatty tissues, and death results subsequent to the appearance of aplasia in the bone marrow.

Thus, it can be concluded that the third type of poisonous effect causes sharply defined changes in the blood-producing processes due to embryonization of the bone-marrow parenchyma. As a result the cellular maturing stage in the blood-producing process disappears and finished elements are released into the peripheral blood. The peripheral blood does not reflect the disruption of hemopoiesis and it is only toward the end of the poisoning period, with the onset of aplasia in the bone marrow, that the hemogram indicates the severity of the poisoning.

The above data shows that experiments on the bone marrow of living animals have valuable implications. For example, in cases where poisons act primarily on the blood-producing process (i.e., where the individual phase of blood production is disrupted and where there is difficulty in determining expected shifts in the peripheral blood) analysis of bone-marrow-puncture specimens will aid in establishing the pathogenesis of poisoning and will also aid in determining methods for prophylaxis against a given type of poisoning. In addition, studies of hemopoiesis may establish the reaction of the organism and may serve as elements for the prognosis of the course of poisoning.

It is necessary to state, however, that there are still many theoretical problems which need to be solved.

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